SCIENCE REVIEW OF A BENTHIC INVERTEBRATE COMMUNITY BASELINE SURVEY REPORT FOR SYDNEY HARBOUR, NOVA SCOTIA

Context

In June, 2010, the Environmental Assessment and Major Projects (EAMP) division of the Oceans, Habitat, and Species at Risk Branch in the Maritimes Region requested that DFO Maritimes Science undertake a review of a document entitled "Marine Benthic Invertebrate Community Baseline Survey, 2009." EAMP requested DFO Science advice on the document related to the following issue:

i) Is the design of the benthic invertebrate survey likely to be effective in determining any potential environment effects from the Sydney Tar Ponds and Coke Ovens Sites Remediation Project?

This information may be used to refine the benthic invertebrate survey to ensure environmental protection objectives are met. It was requested that a response be provided within a few weeks. Given the short timeframe for review, DFO's Science Special Response Process was used.

Background

On October 1, 2007, after a panel review under the Canadian Environmental Assessment Act (CEAA) the Government of Canada permitted the Sydney Tar Ponds and Coke Ovens Sites Remediation Project to proceed. Recommendation 19 of the Panel Report stated, "The Panel recommends that PWGSC [Public Works and Government Services Canada], in consultation with NRCan [Natural Resources Canada], DFO, Environment Canada, and STPA [Sydney Tar Ponds Agency], design a long-term monitoring program to document improvements in the environmental quality of Sydney Harbour. DFO should assume the lead for long-term monitoring." As stated in the Government of Canada response to the Panel Report, DFO would not assume the lead but is a key player in the review of the Environmental Effects Monitoring (EEM) program.

In 2008, the Sydney Tar Ponds Agency initiated an EEM program for Sydney Harbour with the overall objective of measuring the preconstruction (baseline) conditions for the watershed. The objective of the present baseline study is to document marine benthic invertebrate conditions prior to the implementation of major remedial works. The data provides reference points for comparison of subsequent monitoring results obtained during the construction and post construction phases of the project.

Response

The study report provides good baseline information for future monitoring; however, there are a number of improvements that could be made concerning sampling design and statistical

analysis that would enhance the assessment and ensure that changes resulting from remediation are detected.

Sampling Design

The report does not indicate the sampling distance between replicates at each sampling station. Benthic invertebrate communities differ on small spatial scales in the order of tens to hundreds of meters. If replicates were taken within a small area, it is possible than any differences observed among the stations are a result of this spatial variation.

Given the large standard deviations associated with the mean abundance, biomass, etc. at each station, it is unlikely that five replicate samples at each station will detect any statistical differences. It is recommended that baseline data be used to determine the appropriate number of replicates required to detect statistical differences of interest.

Objectives

The general objective of the assessment is to monitor the benthic invertebrate community and detect any changes resulting from remediation. There is no mention, however, of comparisons among stations or among impacted and control sites. Specific objectives are imperative to guide the analysis and interpretation of data. The assessment would benefit from clearly stated objectives that could be addressed using statistical analysis that could be included in future reports.

Statistical Analysis

Within the report, there is a lack of statistical analyses that should be addressed in order to direct future sampling. The report includes ordinations based on community composition data at each station. This analysis is very useful and clearly illustrates differences in benthic invertebrate composition between sites; however, statistical analyses are not performed on other measured parameters. Given the large variance within each site, the qualitative descriptions comparing the differences among stations are not considered robust and it is recommended that quantitative comparisons be made.

A power analysis indicating whether the statistical tests used throughout the report can detect the desired differences in community biomass and/or other parameters over time should be included in future reports. The large variance observed within stations suggests that statistical power is currently insufficient. The questions addressed by the power analysis should be directed by the objectives.

To ensure statistical comparisons of measured parameters across time and stations are achieved, the use of ANOVAs (analysis of variance) should be considered. The use of ANOVAs with total abundance, total biomass, richness diversity, or major benthic components as the dependent variable, and station as the independent variable, will omit any subjective and qualitative interpretation of the results. As sampling is conducted over time, a second independent variable (year) could be included in the analysis. This type of analysis would allow the results to be scientifically defensible when under review.

A wide body of literature illustrating how benthic community composition, abundance, etc., is determined by various physical and environmental parameters is available. Whether changes in sediment parameters resulting from remediation causes changes in benthic communities appears to be a central question of the assessment. Given the data on physical parameters

collected at each station, the completion of a multiple regressions would be considered very useful in addressing this question.

Conclusions

The study report provides good baseline information for future monitoring; however, several aspects of sampling design and statistical analysis should be addressed and improved to ensure the objectives of the marine benthic invertebrate survey can be satisfied. Currently, the report does not provide clear objectives that can be used to guide future sampling and analysis or provide information to ensure that an adequate number of replicates and, subsequently, statistical power are being used to ensure future comparisons will detect changes resulting from remediation. Inclusion of sampling protocols, objectives, and statistical analyses would enhance the document and also provide evidence that the program objectives would be met.

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